Remarks

Reconsideration of this Application is respectfully requested. Applicants have amended claim 41 so that it is no longer a substantial duplicate of claim 40.

Upon entry of the foregoing amendment, claims 34-49 are pending in the application, with claim 34 being the independent claim. The changes incorporated herein are believed to introduce no new matter, and entry is respectfully requested.

Based on the above amendment and the following remarks, Applicants respectfully request that the Examiner enter this amendment and withdraw all outstanding rejections.

Rejections Under 35 U.S.C. § 102(b)

Barkey

The Examiner rejected claims 34, 38, 40, 41, 42, 44 and 49 under 35 U.S.C. § 102(b) as being anticipated by German Patent Application DE 43 16 163 A1 to Barkey ("Barkey"). The Examiner states that "Barkey discloses a method for drying a liquid sample comprising the steps of receiving a container containing the sample; directing a gas into the container; pressurizing the gas (by gas blower); heating the sample in the container (by heated block 12); and heating the sample to a temperature based on the sensed sample level."

Applicants traverse this rejection. The present invention relates to a method for drying solutions containing macromolecules. Claim 34, the sole independent claim, recites the step of "receiving a vessel containing the solution," wherein the "solution" is recited in the preamble as "containing macromolecules." The specification describes macromolecules as including,

> DNA, proteins, lipids, carbohydrates, RNA, oligonucleotides, polypeptides, cells, antibiotics, chemical compounds,

> enzymes (DNA or RNA polymerase such as thermostable DNA polymerase include *Taq*, *Tma*, or *Tne* DNA polymerases, restriction endonucleases, ligases, reverse transcriptases, etc.), antibodies or combinations thereof.

(Pages 7-8, para. 0051).

Barkey relates to a process and device for evaporating samples. Specifically, Barkey states that the samples contain "water and acid . . . and drinking water and wastewater." See translation of Barkey (copy attached), p. 2, "Discussion", para. 2. The samples disclosed by Barkey do not fall within the scope of the definition of "macromolecules" as used in the specification and claims of the present invention. As such, Barkey does not disclose the step of "receiving a vessel containing the solution", as recited in claim 34.

Accordingly, Barkey does not anticipate the invention as set forth in claim 34. Claims 38, 40-42, 44 and 49 depend from and add additional features to claim 34. As such, these claims are patentable for at least the same reasons as set forth above with respect to claim 34. Accordingly, Applicants respectfully request that the Examiner reconsider and withdraw this rejection.

Mills

The Examiner rejected claims 34, 36, 38, 40, 41, 44 and 45 under 35 U.S.C. § 102(b) as being anticipated by Great Britain Provisional Specification GB 202,082 to Mills *et al.* ("Mills"). The Examiner states that "Mills *et al.* disclose a method for drying blood albumen and other liquids comprising the steps of receiving a vessel (f) containing blood albumen and other liquid; directing hot air into the vessel; pressurizing the air (by gas blower); heating the air (by heater a); and heating the sample in the vessel (by heated air)."

Applicants traverse this rejection. The present invention relates to a method for drying solutions containing macromolecules. Claim 34, the sole independent claim, recites

the steps of "receiving a vessel containing the solution" and "directing a gas into the vessel." The Examiner points to element (f) in Mills for teaching a "vessel". Mills describes element (f) as being a chest or chamber with a series of open metal trays carried on end supports or shelves. See Mills, p. 2, col. 1, lines 51-57. Mills shows discharging streams of hot air *between* the superposed open metal trays. See Mills, p. 2, col. 2, lines 65-68. Mills does not disclose "directing a gas *into* the vessel," as recited in claim 34. Rather, the circulated hot air acts against the bottom of one row of trays and on the moisture rising from the liquid contained in the trays below. See Mills, p. 2, col. 2, lines. 68-72. Thus, Mills does not direct hot air into the trays. The present invention relates to directing the gas into the vessel to dry the solution contained in the vessel.

Accordingly, Mills does not disclose the invention as set forth in claim 34. Claims 36, 38, 40, 41, 44 and 45 depend from and add additional features to claim 34. As such, these claims are patentable for at least the same reasons as set forth above with respect to claim 34. Accordingly, Applicants respectfully request that the Examiner reconsider and withdraw this rejection.

Rejections Under 35 U.S.C. § 103

Barkey In View of Olesen

The Examiner rejected claims 35-37 and 39 under 35 U.S.C. § 103(a) as being unpatentable over Barkey in view of U.S. Patent No. 6,122,837 to Olesen *et al.* ("Olesen"). In particular, the Examiner asserted,

> The drying method of Barkey as disclosed above includes all that is recited in claims 35-37 and 39 except for the steps of filtering the gas, heating the gas and controlling the gas temperature and pressure. Olesen *et al.* teach a method of

> drying comprising the steps of filtering the gas, heating the gas, and controlling the gas temperature and pressure same as claimed. (see Fig. 4) Therefore, it would have been obvious . . . to modify the drying method of Barkey to include the [teachings of] . . . Olesen *et al.* in order to improve drying efficiency.

Office Action, pages 3-4.

Claims 35-37 and 39 depend from and add additional features to claim 34. Olesen does not disclose the feature of drying a solution containing macromolecules that Barkey fails to disclose, as discussed above. Even if it were obvious to combine Barkey and Olesen, doing so would not result in the claimed invention. As such, claims 35-37 and 39 are patentable over the combination of Barkey in view of Olesen. Accordingly, Applicants respectfully request that the Examiner reconsider and withdraw this rejection.

Mills In View of Olesen

The Examiner rejected claims 35, 37 and 39 under 35 U.S.C. § 103(a) as being unpatentable over Mills in view of Olesen. In particular, the Examiner asserted,

> The drying method of Mills includes all that is recited in claims 35, 37 and 39 except for the steps of filtering the gas, controlling the gas temperature and pressure. Olesen *et al.* teach a method of drying comprising the steps of filtering the gas, controlling the gas temperature and pressure same as claimed. (see Fig. 4) Therefore, it would have been obvious . . . to modify the drying method of Mills to include the [teachings of] . . . Olesen *et al.* in order to improve drying efficiency.

Office Action, page 4.

Claims 35, 37 and 39 depend from and add additional features to claim 34. Olesen does not disclose the feature of directing a gas into a vessel containing macromolecules that Mills fails to disclose, as discussed above. Even if it were obvious to combine Mills and Olesen, doing so would not result in the claimed invention. As such, claims 35, 37 and 39

are patentable over the combination of Mills and Olesen. Accordingly, Applicants respectfully request that the Examiner reconsider and withdraw this rejection.

Barkey

The Examiner rejected claims 43 and 45 under 35 U.S.C. § 103(a) as being unpatentable over Barkey. The Examiner states that Barkey discloses "all that is recited in claims 43 and 45 except for the steps of tilting the vessel and directing the gas substantially horizontal to the solution." Further, the Examiner states that it would have been an obvious matter of design choice to modify Barkey to provide these missing steps in order to obtain the optimum drying result.

Claims 43 and 45 depend from and add additional features to claim 34. As such, these claims are patentable for at least the same reasons as set forth above with respect to claim 34. Accordingly, Applicants respectfully request that the Examiner reconsider and withdraw this rejection.

Mills

The Examiner rejected claims 42 and 43 under 35 U.S.C. § 103(a) as being unpatentable over Mills. The Examiner states that Mills discloses "all that is recited in claims 42 and 43 except for the steps of tilting the vessel and performing the drying on the plurality of vessels." Further, the Examiner states that it would have been an obvious design choice to modify Mills to provide these missing steps in order to obtain the optimum drying result.

Claims 42 and 43 depend from and add additional features to claim 34. As such, these claims are patentable for at least the same reasons as set forth above with respect to

claim 34. Accordingly, Applicants respectfully request that the Examiner reconsider and withdraw this rejection.

Conclusion

All of the stated grounds of rejection have been properly traversed, accommodated, or rendered moot. Applicants therefore respectfully request that the Examiner reconsider all presently outstanding rejections and that they be withdrawn. Applicants believe that a full and complete reply has been made to the outstanding Office Action and, as such, the present application is in condition for allowance. If the Examiner believes, for any reason, that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at the number provided.

Prompt and favorable consideration of this Amendment and Reply is respectfully requested.

Respectfully submitted,

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Version with markings to show changes made

Claim 41 is amended as follows:

41. (Twice Amended) The method according to claim [34] 40, further comprising the steps of:

[(3) heating the solution in the vessel.]

(4) monitoring a temperature of the solution; and

(5) adjusting the temperature of the solution to correspond to a desired temperature.

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Request for examination according to § 44, Patent Act, has been submitted.

(54) Process and device for evaporating samples

(57) [insert figure]

In a process for evaporating samples in sample vessels by adding heat, a stream of gas is blown continuously onto the sample in the sample vessel. The sample temperature is determined continuously, and the heat input to the sample is adjusted so that the sample temperature remains continuously in a specified range. A device for carrying out the process comprises a metallic heating block (12) with drilled holes (14, 16) to hold sample vessels, a gas-blowing device (30, 40) with a multiplicity of gas-blowing capillaries (40), each of which can be inserted into a sample vessel, and a temperature sensor for the sample vessels which is connected to the temperature controller for the heating block (12) and which controls the heating block temperature so that the sample temperature remains continuously in a specified range.

The following statements are taken from the document submitted by the applicant.

Description

The invention concerns a process for evaporating samples in sample vessels by adding heat, and a device for carrying out that process.

Evaporation of liquid samples is one of the sample preparation methods widely used in laboratories. As the sample vessels are usually test tubes or similarly narrow vessels, the gas phase resulting from evaporation can be removed only slowly. Therefore the evaporation of sample materials, especially samples containing water and acid, with normal convection is time-consuming. With respect to increasing the temperature, it must be noted that the temperature must be adjusted according to the volatility of the sample material. Boiling and "bumping" must be avoided and the evaporation of the sample material must be gentle enough that the material to be determined is not lost. However, it is generally desirable that the sample material be evaporated and analyzed as quickly as possible. That is particularly true for trace analysis of drinking water and wastewater samples, for example. They must be analyzed rapidly in case of interruptions to operations or accidents. Shortening of the evaporation time is obviously desirable even in normal routine operation, because it allows increasing sample throughput and thus better utilization of the laboratory equipment, which is usually expensive.

Producing movement of air or gas in the vicinity of the samples by a suitable means, thus increasing the removal of the gas phase produced by evaporation, is a known way of accelerating evaporation. The success of this measure is relatively minor, though, because the increased evaporation and the heat of evaporation linked with it results in a drop in the sample temperature. With highly volatile solvents, ice can actually be produced on the sample vessels from the moisture of the air. This drop in temperature is, to be sure, compensated for by adding heat, but that is relatively slow because the heating equipment usually used in laboratories, such as temperature-controlled metal blocks with drilled holes to hold the sample vessels are essentially set to the desired evaporation temperature at which boiling of the sample material and the resulting boiling losses can be prevented.

The invention is based on the objective of providing a process and a device which makes it possible to shorten the evaporation time substantially.

This objective is attained by a process of the generic nature in such a way that a flow of gas is blown continuously on the surface of the sample material, that the temperature of the sample is determined continuously, and that the heat input to the sample is regulated so that the temperature of the sample material remains continuously in a specified range.

Continuous monitoring of the temperature in the sample material offers the possibility of controlling the temperature of the heating device, and thus the heat input, so that the preset temperature in the sample material always remains constant in spite of continuous cooling and an equilibrium can be produced between continuous cooling and heat input.

A device according to the invention for carrying out the process comprises a heating block with drilled holes to hold sample vessels. It is characterized by a gas blowing system having a multiplicity of capillaries, each of which can be inserted into one of the sample vessels, as well as a temperature sensor for the sample vessels which is connected to the temperature control system

of the heating block and which controls the heating block temperature so that the sample temperature remains continuously in the specified range.

It is preferable to provide sensors to scan the sample levels in the sample vessels, and the capillaries can be lifted and lowered automatically so that they can follow the sample level and be maintained at a specified distance from it.

As the temperature of the samples is always controlled automatically, the gas blown out can be at room temperature or at an elevated temperature. Nitrogen or another gas can be used in place of air if that is desirable for the particular analysis. The gas flow per unit time can be set high without the danger of excess cooling of the sample.

Heating of the air or gas flow can prevent recondensation on the inner walls of the sample vessel above the sample level or even on the capillaries, so that the danger of contamination is avoided.

It is preferable for the temperature of the samples and the height of the sample level to be determined by using only one sample which is considered representative.

Even if the heating block temperature is controlled depending on the sample temperature, all the significant parameters such as the throughput and temperature of the gas blown through, the size of the sample, the distance of the blowing capillary from the sample surface, the level of fill of the sample vessel, etc., there can be other possibilities for adjusting the temperature control for the heating block, such as an adjustment between the fastest possible evaporation on one hand or a particularly gentle evaporation on the other hand.

One preferred embodiment of the invention is explained in the following, using the accompanying drawings.

Figure 1 shows in a schematic form a device according to the invention.

A device according to the invention comprises a box-like housing 10, into which is set a rectangular heating block 12, particularly of metal. The upper surface of the heating block 12 is open. Holes 14, 16 are drilled vertically into the block from the top. Sample vessels, typically in the form of test tubes, can be inserted into those holes 14, 16. Because of the high thermal conductivity of the block material and its high heat capacity, a heating block of this type can be heated through very evenly and high quantities of heat can be transferred into the sample vessels in the holes 14, 16, warming those sample vessels relatively quickly and evenly. Heating blocks of this type are known, and so do not require more detailed explanation.

At the front of the housing 10 there is a switch panel 18 for the necessary settings. Heating blocks of the type shown are usually brought to the desired temperature using electrical heating elements. Two vertical supports 20, 22, 24, 26 rise at each side of the top of the housing 10. They are held together by a rectangular head piece 28 at their upper ends. A box-like blower housing 30 is mounted so that it can slide upward and downward on the supports 20, 22, 24, 26. With respect to them, there is a drive and guide box at the right and left ends of the blower housing in Figure 1. They can be driven in the vertical dimension on the supports 20, 22 at one side and 24, 26 at the

other side. There is a spindle 36, 38 between, and parallel with each pair of supports, 20, 22 and 22, 24. The spindles 36, 38 also connect the upper side of the housing 10 with the head piece 28.

The spindles can be driven by means of a drive motor which is not shown, which can be placed in the housing 10 or in the head piece 28. They can run through a solidly installed spindle follower where they pass through the drive and guide boxes 32, 34. Alternatively, the spindles 36, 38 can be solidly mounted and there can be rotatable spindle drive nuts in the drive and guide boxes 32, 34. The arrangement depicted makes it possible to move the blower housing 30 upward and downward with its own drive.

Inside the blower housing 30 there are a blowing device and a temperature control means, especially a heating means, from which the temperature-controlled gas, such as air or nitrogen, is released. For that purpose, blowing capillaries 40 are arranged vertically, directed downward, on the under side of the blower housing 30. They are arranged in a pattern which matches that of the holes 14, 16 and thus matches that of the sample vessels, not shown, which stand in the holes.

After the sample vessels are inserted into the holes 14, 16, the blower capillary tubes 40 are lowered into the sample vessels down to a specified height with respect to the sample level. Then their height is controlled automatically.

One of the capillary tubes 40 shown in Figure 1 is given a probe 42 which determines the heights of the sample levels and which produces a signal through a control system, not shown, to adjust the position of the blower housing 30 and of the capillaries. It is generally sufficient to determine the height of the sample level and the sample temperature in just one representative sample vessel. The probe 42 also determines the lower final level at which the evaporation is terminated. The temperatures determined are conducted to a heating block temperature control inside the housing 10 which processes the signals so that the heating block temperature is held continuously at a value at which the sample temperature has the specified temperature value. Figure 1 also shows a supplementary external control unit 44 which can, for example, be used to adjust the height of the blower housing 30 and to control the flow rate and temperature of the gas stream. This control unit 44 can also be integrated into the housing 10.

Figure 2 is a partial sectional view of the heating block 12 with a drilled hole 14 and a sample vessel 46 inserted into the hole. The Figure also shows a blowing capillary 40 and the previously mentioned probe 42 to determine the sample level. A temperature sensor 48 is also inserted into the sample. It is connected through a line 50, in a manner not shown, to the control means for the device, as previously explained above.

Figure 2 also shows a gripping means 52 which makes it possible to grasp a sample vessel 46 and raise it or lower it together with the blower housing 30. That gives the possibility of lifting the samples out of the holes 14, 16 of the heating block 12 after termination of the evaporation process and cooling them to interrupt the evaporation. Otherwise, evaporated samples left in the block could be overheated and damaged because of the high thermal inertia of the heating block even after the heating of the heating block is switched off.

Patent Claims

1. Process for evaporating samples in sample vessels by adding heat,
characterized in
that a flow of gas is blown continuously onto the sample in the sample vessel,
that the temperature of the sample is determined continuously, and
that the heat input to the sample is adjusted so that the temperature of the sample material remains continuously in a specified range.

2. Device for carrying out the process of Claim 1 with a heating block (12) having drilled holes (14, 16) to hold sample vessels,
characterized by
a gas blowing means (30, 40) having a multiplicity of blowing capillaries (40), each of which can be lowered into a sample vessel (46) and by a temperature sensor (48, 50) assigned to one of the sample vessels, which sensor is connected to the temperature control of the heating block (12) and which controls the heating block temperature so that the sample temperature remains continuously in a specified range.

3. Device according to Claim 2,
characterized by
a sensor (42) to determine the particular sample level and an automatic drive means (32, 34, 38) which always holds the height of the outlet end of the blowing capillary (40) at a constant distance from the height of the sample level.

4. Device according to one of Claims 1 to 3,
characterized by
a raisable and lowerable gripping means (52) to raise and lower the sample vessels (46) with respect to the heating block (12).

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with 2 pages of drawings
